Driving-Force Transmitting Part, Electrophotographic Photosensitive Drum, Process Cartridge and Electrophotographic Image Forming Apparatus

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to a driving-force transmitting part, and an electrophotographic photosensitive drum, a process cartridge and an electrophotographic image forming apparatus using the driving-force transmitting part.

Here, the electrophotographic image forming apparatus refers to an apparatus for forming an image on a recording medium by the use of the electrophotographic image forming process, and the term "electrophotographic image forming apparatus" covers an electrophotographic copier, an electrophotographic printer, (a laser printer, an LED printer or the like), a facsimile apparatus, a word processor or the like.

Also, the process cartridge may refer to charging means, developing means or cleaning means and an electrophotographic photosensitive drum integrally made into a cartridge which is made detachably mountable to the main body of the image forming apparatus. Alternatively, the process cartridge may refer to at least one of charging means, developing means and cleaning means and an electrophotographic photosensitive

drum integrally made into a cartridge, which is made detachably mountable to the main body of the image forming apparatus. Further alternatively, the process cartridge may refer to at least developing means and an electrophotographic photosensitive drum integrally made into a cartridge, which is made detachably mountable to the main body of the apparatus.

Description of the Related Art

In image forming apparatus using the electrophotographic image forming process, there has heretofore been adopted a process cartridge system in which an electrophotographic photosensitive member and process means for acting on the electrophotographic photosensitive member are integrally made into a cartridge, which is made detachably mountable to the main body of the image forming apparatus. According to this process cartridge system, one maintenance of the apparatus can be done by a user himself without resorting to a serviceman and therefore, the operability of the apparatus could be markedly improved. So, this process cartridge system has been widely used in the image forming apparatuses.

In an image forming apparatus to which such a process cartridge is detachably mountable, a driving device is disposed in the main body of the image forming apparatus, and a driving force is transmitted in each process means of the process cartridge through driving-

force transmitting means. As such driving-force transmitting means, Japanese Patent Applications Laid-Open No. 08-328449 proposes means as shown in Fig. 11 of the accompanying drawings, wherein as a method, a driving shaft 100 formed with a twisted-polygonal recess 101 (in the shown example, a twisted-polygonal hole having a substantially equilateral triangular cross-section) is provided on the image forming apparatus side, and as shown in Fig. 10 of the accompanying drawings, a first flange 210 is formed with a twisted-polygonal prism-shaped protrusion 211 (in the example of Fig. 10, a twisted equilateral triangular prism having a substantially equilateral triangular cross-section) as driving-force transmitting means, and the protrusion 211 is inserted in the recess 101 to thereby transmit the driving force.

In the driving device, the transmission of the driving force is effected from the recess 101 to the protrusion 211 inserted in the recess 101 and therefore, the driving side and the driven side are normally in contact with each other and it becomes easy to improve the accuracy of rotation. Also, the vertices of the protrusion 211 tend to equally contact with the inner surface of the recess 101 and therefore, the axes are aligned with each other. Further, the two have the twisted shapes and therefore, forces act on the recess 101 and the protrusion 211 in a direction to attract them

to each other and thus, the positioning of the photosensitive drum in the lengthwise direction thereof becomes easy.

In such an apparatus as previously described, the driving force transmitted to the first flange 210 is transmitted to a developing roller 41 shown in an embodiment of the present invention through a gear portion 213 provided on the flange, and to a transfer roller 70 through a second gear portion 221. In the example of the conventional art, a fit-sliding portion 212 is provided so as to protrude from the end surface perpendicular to the axis of the first gear portion 213. The fit-sliding portion 212 is fitted to and supported by a bearing provided in a cartridge frame.

The construction described in the aforementioned publication is practically very excellent as a driving system for an electrophotographic photosensitive drum.

The present invention is a further development of the conventional art proposed in the aforementioned Japanese Patent Application Laid-Open No. 08-328449.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a driving-force transmitting part, an electrophotographic photosensitive drum, a process cartridge and an electrophotographic image forming apparatus which can efficiently effect the transmission of a driving force.

It is another object of the present invention to provide a driving-force transmitting part, an electrophotographic photosensitive drum, a process cartridge and an electrophotographic image forming apparatus which enables the length of the electrophotographic photosensitive drum to be shortened.

It is another object of the present invention to provide a driving-force transmitting part, an electrophotographic photosensitive drum, a process cartridge and an electrophotographic image forming apparatus in which the accuracy of the rotation of the electrophotographic photosensitive drum could be improved.

It is another object of the present invention to provide a driving-force transmitting part, an electrophotographic photosensitive drum, a process cartridge and an electrophotographic image forming apparatus which can reliably effect the transmission of a driving force from the main body of the apparatus to the electrophotographic photosensitive drum.

It is another object of the present invention to provide a driving-force transmitting part, an electrophotographic photosensitive drum, a process cartridge and an electrophotographic image forming apparatus which has realized downsizing along the lengthwise direction of the electrophotographic photosensitive drum.

It is another object of the present invention to

provide a driving-force transmitting part provided at a lengthwise end of an electrophotographic photosensitive drum, and having a twisted projection of which the cross-section has a plurality of corners, a shaft portion supported by a bearing portions, and a gear portion for transmitting a driving force to a developing roller, the shaft portion and the gear portion overlapping each other in the axial direction of the electrophotographic photosensitive drum, an electrophotographic photosensitive drum, a process cartridge and an electrophotographic image forming apparatus.

These and other objects, features and advantages of the present invention will become more apparent upon consideration of the following description of the preferred embodiments of the present invention taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a longitudinal cross-sectional view of an image forming apparatus.

Fig. 2 is a longitudinal cross-sectional view of a process cartridge.

Figs. 3A and 3B are cross-sectional views, taken along a plane perpendicular to an axis, of a protrusion and a recess which are driving-force transmitting means.

Fig. 4 is a perspective view showing the first flange of Embodiment 1.

Fig. 5 is a perspective view showing the first flange of Embodiment 1.

Fig. 6 is a partly developed cross-sectional view of the process cartridge of Embodiment 1.

Fig. 7 is a perspective view showing the first frame of Embodiment 1.

Fig. 8 is a perspective view showing the drum bearing of Embodiment 1.

Fig. 9 is a perspective view showing the drum bearing and drum shaft of Embodiment 1.

Fig. 10 is a perspective view showing a photosensitive drum according to the conventional art.

Fig. 11 is a perspective view of a driving shaft.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

(Embodiment 1)

(General Construction)

Figs. 1 and 2 schematically show an image forming apparatus 1 and a process cartridge 2, respectively, according to the present invention. The image forming apparatus is a laser printer utilizing the electrophotographic art to which the process cartridge 2 is detachably mounted.

When the process cartridge 2 is mounted to the image forming apparatus 1, an exposure device (laser scanner unit) 3 is mounted above the process cartridge 2, and a sheet tray 4 containing therein recording mediums

(sheets) P on which image formation is to be effected is disposed on the inner side (the right side as viewed in Fig. 1) of the process cartridge 2. Further, in the image forming apparatus 1, a feed roller 5, a transfer guide 6, a transfer device 7, a transporting guide 8, a fixing device 9, a pair of delivery rollers 10, and a delivery tray 11 are disposed along the transporting direction of the sheet P. The process cartridge 2 integrally contains therein four kings of process devices, i.e., an electrophotographic photosensitive drum (hereinafter referred to as the photosensitive drum) 20, a charging device 30, a developing device 40 and a cleaning device 50.

The mounting of the process cartridge 2 is effected by opening an openable and closable cartridge door 1a, and inserting a guided portion (not shown) provided on the process cartridge 2 into a guide (not shown) provided in the image forming apparatus 1, and the process cartridge 2 and the image forming apparatus 1 are connected together at one end side thereof by driving-force transmitting means which will be described later. The other end side of the process cartridge 2 is positioned by the guide portion and the guided portion, but one end side of the process cartridge 2 is positioned by the connection of the driving-force transmitting means.

(Description of the Image Forming Process)

The epitome of image formation will now be

described. On the basis of a print starting signal, the photosensitive drum 20 is rotatively driven at a predetermined peripheral speed (process speed) in the direction of arrow R. A charging roller 31 forming the main portion of the charging device 30 is in contact with the outer peripheral surface of the photosensitive drum 20 with a predetermined voltage applied thereto, and the outer peripheral surface of the photosensitive drum 20 is uniformly charged to predetermined potential.

A laser beam L modulated correspondingly to the time-series electrical digital pixel signal of desired image information is outputted from the exposure device 3 which is a laser scanner unit, and enters the interior of the process cartridge 2 from the exposure window portion 2b of the upper surface of the process cartridge 2 and scans the outer peripheral surface (photosensitive layer) of the photosensitive drum 20. Thereby, an electrostatic latent image corresponding to the desired image information is formed on the outer peripheral surface (photosensitive layer) of the photosensitive drum 20. This electrostatic latent image is developed as a toner image, by a developer (toner) T supplied from the developing device 40.

On the other hand, a sheet P is fed from the sheet tray 4 by the feed roller 5 in timed relationship with the outputting of the laser beam L, and is timing supplied to the transferring position between the

photosensitive drum 20 and a transfer roller 70 forming the main portion of the transfer device 7, via the transfer guide 6. At this transferring position, the toner image is sequentially transferred from the photosensitive drum 20 to the sheet P.

The sheet P to which the toner image has been transferred is separated from the photosensitive drum 20 and is transported to the fixing device 9 along the transporting guide 8, and passes through the nip portion between a fixing roller 9a and a pressure roller 9b, and the pressurizing and heat fixing process is carried out in this nip portion, and the toner image is fixed on the sheet P. The sheet P on which the toner image has been fixed is transported to the pair of delivery rollers 10, and is delivered onto the delivery tray 11.

On the other hand, after the transfer, the photosensitive drum 20 has any residual toner on its outer peripheral surface removed by the cleaning device 50 and is again used for image formation beginning from charging.

(Description of the Photosensitive Drum)

The photosensitive drum 20, as shown in Fig. 6, is comprised of a drum cylinder 200 having a photosensitive layer formed on the outer peripheral surface of a cylinder formed of a nonmagnetic electrically conductive material such as aluminum, a first flange 210 fixed to one end of the drum cylinder 200, and a second flange 220

fixed to the other end of the drum cylinder 200.

The first flange 210 has a projection-shaped protrusion 211 as a driving-force transmitted portion which will be described later, a rotary sliding portion 212 which is a supported portion which will be described later, a first gear portion 213 as a driving-force transmitting portion to a unit internal mechanism, a second gear portion 221 for rotatively driving the transfer device 7 which will be described later, and a first coupling portion which is a fixed portion fitted and fixed to the drum cylinder 200, and is fitted and fixed to the drum cylinder 200 at the first coupling portion 214. In the present embodiment, the first gear portion 213 is a helical gear, and the second gear portion 221 is a spur gear.

The second flange 220 has a second coupling portion 222, and is fitted and fixed to the drum cylinder 200 at the second coupling portion 222.

A hole 211b is formed in the axis portion of the first flange 210, and an earth pin 215 is forced in this hole 211b. An earth plate 216 is attached to the inner end surface of the first flange 210, and the drum cylinder 200 and the protrusion side and surface 215a of the earth pin 215 electrically conduct to each other. The second flange 220 is rotatably supported by a drum shaft 350 (see Fig. 9) fitted in the central hole 220b thereof. This drum shaft 350 is fixed to a frame 2a

shown in Figs. 4 and 9. The fixing of the first and second flanges 210 and 220 to the drum cylinder 200 is done by caulking, adhesive securing or force-fitting.

The photosensitive drum 20 is rotatably mounted on the frame 2a by means of a drum bearing 302 disposed at one end side thereof which is shown in Figs. 8 and 9, and a drum shaft 350 disposed at the other end side thereof. The drum bearing 302 has a base portion 303, a cover portion 305 and a small screw hole 306 as fixing means. The first gear portion 213 of the first flange 210, in its assembled state, is covered with the cover portion 305 of the drum bearing 302 and the protective wall 310 of the frame 2a, as shown in Fig. 7. Further, the second gear portion 221 is protected by a shutter member (not shown) for protecting the photosensitive drum 20.

(Description of the Developing Device)

As shown in Fig. 2, the developing device 40 has a developing roller 41 as means for containing a toner T therein and supplying the toner T to the photosensitive drum 20. The developing roller 41 having its opposite ends rotatably supported by a cartridge frame 2d contains a magnet roller 43 therein, and further as shown in Fig. 6, has a developing roller gear 44 mounted on one end thereof. The developing roller gear 44 meshes with the first gear portion 213 of the photosensitive drum 20 to thereby form a gear train, and the developing roller 41 is rotatively driven.

At this time, the toner T is attracted to the vicinity of the developing roller 41 by the magnetic force of the magnet roller 43, is carried toward a developing blade 42 by the rotation of the developing roller 41, and has its layer thickness regulated by the developing blade 42 and has predetermined charges imparted thereto, and is carried toward the photosensitive drum 20.

(Description of the Transfer Device)

The transfer device 7, as shown in Fig. 6, is comprised of a transfer roller 70 having an electrically conductive coating layer formed on the outer periphery of a core material, a transfer roller gear 71 fixed to one end portion of the transfer roller 70, and transfer bearings 72 and transfer springs 73 disposed on the opposite ends of the transfer roller 70. The transfer roller gear 71 cooperates with the second gear of the photosensitive drum 20 to form a gear train, and the transfer roller 70 is rotatively driven while being biased toward the photosensitive drum 20. Also, at least one transfer bearing 72 and at least one transfer spring 73 together form an electric power supply path, and in case image formation, a predetermined transfer bias is supplied to the transfer roller 70. The transfer bearings 72 are movably provided on a guide, not shown, in a direction linking the centers of the photosensitive drum 20 and the transfer roller 70 together. The guide

is provided in the image forming apparatus 1.

(Description of the Driving-Force Transmission)

Reference is now had to Figs. 4, 5 and 6 to describe the protrusion 211 of the first flange 210 which provides the driving-force transmitted means of the image forming apparatus 1 and the process cartridge 2, and a recess 101 formed in a driving shaft 100.

The first flange 210, as shown in Fig. 6, has the first coupling 214 fitted in and fixed to the drum cylinder 200, the second gear portion 221, the first gear portion 213, the rotary sliding portion (shaft portion) 212 overlapping the first gear portion 213, and the protrusion 211 which is of an axial projection shape having a protrusion side end surface 211a provided on the end surface of the rotary sliding portion 212 axially in the named order and molded integrally with one another. As is apparent from Figs. 4 and 6, a portion of the rotary sliding portion (shaft portion) 212 is surrounded by the gear portion 213.

The protrusion 211 of the first flange 210 which is the driving-force transmitted means has a twisted prism shape having a substantially equilateral triangular cross-section. On the other hand, the driving shaft 100 is disposed in the image forming apparatus 1 at a location corresponding to the protrusion 211. The tip end portion of the driving shaft 100 is formed with a twisted polygonal recess 101 having a substantially

equilateral triangular cross-section into which the protrusion 211 is insertable.

The driving shaft 100 is connected to the cartridge door 1a by a mechanism, not shown, and is designed to be axially pulled into the image forming apparatus 1 in the opened state of the cartridge door 1a, and be axially biased toward the process cartridge 2 with predetermined pressure by a spring in the closed state of the cartridge door 1a. Therefore, the protrusion 211 of the first flange 210 and the recess 101 of the driving shaft 100 fit together during the closing of the cartridge door 1a or immediately after the start of driving.

The driving shaft 100 is provided with a large gear, not shown, coaxially therewith, and rotation is transmitted from a motor, not shown, mounted in the main body 14 of the apparatus to this large gear by a gear train (not shown). The above-mentioned large gear and gear train will hereinafter be referred to as the apparatus main body gears or the main body gears.

In a state in which the process cartridge 2 is inserted in the image forming apparatus 1, one end side of the process cartridge 2 opposed to the driving shaft 100 which corresponds to one end side of the drum cylinder 200 is radially held relative to an operating position with play or slop by means, not shown, and therefore, as shown in Fig. 3A, the axis Y of the protrusion 211 and the axis X of the recess 101 deviate

from each other by an amount corresponding to the aforementioned play or slop. However, when the driving shaft 100 is rotatively driven with the protrusion 211 inserted in the recess 101, the vertices 211c of the protrusion which are the chamfered ridges of the protrusion 211 try to equally abut against the inner surface 101a of the recess 101. Here, the axis of the driving shaft 100 formed with the recess 101 is provided so as to be immovable relative to the frame of the image forming apparatus and therefore, the axis Y of the protrusion aligns with the axis X of the recess (see Fig. 3B). Further, a force acts on the recess 101 and the protrusion 211 in directions to attract them to each other by the twisted-shape thereof and therefore, the photosensitive drum 20 is attracted to the driving shaft 100 side, and is positioned bodily with the process cartridge 2, and the photosensitive drum 20 is rotatively driven. At this time, the developing roller 41 has a driving force transmitted thereto via the first gear portion 213 and the developing roller gear 44, and the transfer roller 70 has a driving force transmitted thereto via the second gear portion 221 and the transfer roller gear 71 and therefore, both the developing roller 41 and the transfer roller 70 are also rotatively driven by the photosensitive drum 20.

As shown in Figs. 5 and 6, an electrically grounded earth contact 102 is provided in the central portion of

the driving shaft 100. The earth contact 102 is biased toward the process cartridge 2 side by biasing means, not shown. When the process cartridge 2 is mounted, the earth contact 102 contacts with the protrusion side end surface 215a of an earth pin 215, and the drum cylinder 200 is electrically grounded.

(Description of the First Flange)

The first flange 210, as previously described, has the protrusion 211, the rotary sliding portion 212, the first gear portion 213, the second gear portion 221 and the first coupling portion 214.

The protrusions 211, as previously described, is the driving-force transmitted means and has a twisted prism shape of which the cross-section is a substantially equilateral triangle. The first gear portion 213, as previously described, cooperates with the developing roller gear 44 to form a gear train, and transmits the driving force transmitted thereto from the protrusion 211 to the developing roller gear 44. The first coupling portion 214 is a coupling portion to the drum cylinder 200, and the first flange 210 is fixed to the drum cylinder 200 by the first coupling portion 214.

The second gear portion 221 is disposed between the first gear portion 213 and the first coupling portion 214, and comes into meshing engagement with the transfer roller gear 71 to thereby form a gear train when the process cartridge 2 is inserted into the image forming

apparatus 1. In the present embodiment, the driving gear 100 and the transfer roller gear 71 are disposed in proximity to each other and it is easier to keep the mutual positional relation at higher accuracy and therefore, in the present embodiment, the gear width of the second gear portion 221 cooperating with the transfer roller gear 71 to form a gear train is made narrower than the gear width of the second gear portion 221 described in connection with the conventional art.

The first flange 210 is rotatably held on a drum bearing 302 fixed to the frame 2a (see Fig. 2) of the process cartridge 2, by the rotary sliding portion (shaft portion) 212, but as previously described, during the operation of the apparatus, the protrusion 211 is attracted until the axis Y of the protrusion aligns with the axis X of the recess 101 of the driving shaft 100 and thus the weight of the process cartridge 2 is applied to the first flange 210. Therefore, in order to keep the surface pressure of the rotary sliding portion 212 of the first flange 210 and the drum bearing 302 adjacent to the frame 2a at a moderate value, the width of the rotary sliding portion 212 is set to a rather great value, but in the present embodiment, the rotary sliding portion 212 is made to pass under the first gear portion 213 to thereby make the rotary sliding portion 212 and the first portion 213 axially overlap each other. One drum bearing 302 comes into the back of the first gear 213, and the

rotary sliding portion 212 and the drum bearing 302 are in a sliding fit relation with each other.

According to the embodiment, the axial length of the first flange 210 which is a driving-force transmitting part is short, and particularly the protruding length from the drum cylinder 200 is short. Accordingly, the axial length of the photosensitive drum 20, the lengthwise dimension of the process cartridge 2 and the width of the image forming apparatus can be made small.

The drive transmitting construction of the driving shaft 100 may be such that the driving shaft 100 has a twisted prism shape having a substantially equilateral triangular cross-section and the first flange 210 side is of a twisted polygonal recess shape having a substantially triangular cross-section into which a twisted prism shape is insertable. Also, in the present embodiment, the first gear portion 213 is a helical gear and the second gear portion 221 is a spur gear, but this is not restrictive.

The above-described embodiment will be summed up and complemented as follows.

Firstly, the electrophotographic photosensitive drum 20 used in the process cartridge 2 detachably mountable to the main body 14 of the electrophotographic image forming apparatus for forming an image on a sheet P which is a recording medium, the main body 14 having

a motor, not shown, provided in the main body 14 of the image forming apparatus 1,

the apparatus main body gear, not shown, for transmitting the driving force of the motor, the apparatus main body gear being coaxial with and integrally having the driving shaft 100, and

the recess 101 provided in the central portion of the main body gear and rotated with the main body gear and which is a non-circular twisted hole of which the cross-section has vertices 211c which are a plurality of corners, and

the electrophotographic photosensitive drum 20 having

(a) the cylinder 200 having a photosensitive layer on the peripheral surface thereof, and

(b) the first flange 210 which is a driving-force transmitting part mounted on one end of the cylinder 200, and having

the second gear portion 221 which is a spur gear for transmitting a driving force received from the main body 14 of the apparatus to the transfer roller 70 provided in the main body 14 of the apparatus when the process cartridge 2 is mounted to the main body 14 of the apparatus,

the first gear portion 213 which is a helical gear provided in juxtaposed relationship with the spur gear 221 for transmitting the driving force received from the

main body 14 of the apparatus to the developing roller 41 provided in the process cartridge 2 when the process cartridge 2 is mounted to the main body 14 of the apparatus,

the rotary sliding portion 212 which is a shaft portion provided in juxtaposed relationship with the helical gear 213 and rotatably supported on the drum bearing 302 which is a bearing portion when the photosensitive drum 20 is mounted in the process cartridge 2, and

the protrusion 211 which is a non-circular twisted projection fitted into the recess 101 which is a hole provided in the main body 14 of the apparatus to receive the transmission of the driving force from the main body 14 of the apparatus when the process cartridge 2 is mounted to the main body 14 of the apparatus and of which the cross-section has a plurality of corners 211c, and

wherein an area rotatably supported by the bearing portion 302 overlaps an area in which the helical gear 213 is provided when the photosensitive drum 20 is mounted in the process cartridge 2 in the axial direction thereof, and

the driving-force transmitting part transmits the driving force received from the main body 14 of the apparatus through the hole 101 and the projection 211 to the cylinder 200 through the helical gear 213 and the spur gear 221, and

transmits the driving force to the developing roller 41 through the helical gear 213, and

transmits the driving force to the transfer roller 70 through the spur gear 221.

Secondly, on the end surface of the helical gear 213, a circular recess is provided on a line coaxial with the axis thereof, and the bearing portion 302 slides with the outer peripheral surface of the shaft portion 212 and the inner peripheral surface of the recess which is continuous from the outer peripheral surface, and rotatably supports the shaft portion 212 and the recess.

Thirdly, the photosensitive drum 20 further has the earth pin 215 as an earth member for grounding the photosensitive drum 20 to the main body 14 of the apparatus when the process cartridge 2 is mounted to the main body 14 of the apparatus and which is provided at the center of the driving-force transmitting part 210 through the same in the axial direction thereof.

Fourthly, the driving-force transmitting part 210 is an integrally molded article of resin comprising the first coupling portion 214 which is a fitted portion fitted to one end of the cylinder 200, the spur gear 221, the helical gear 213 and the projection 211 molded integrally with one another.

Fifthly, the tooth width of the spur gear 221 is narrower than the tooth width of the helical gear 213, and the number of teeth of the spur gear 221 is smaller

than the number of teeth of the helical gear 213.

Sixthly, the shape of the protrusion 211 is a substantially equilateral triangular prism, and the protrusion vertices 211c which are the corners of the substantially equilateral triangular prism are chamfered, and the protrusion 211 is fitted in the hole 101 of which the cross-section is a substantially equilateral triangle.

Seventhly, the process cartridge 2 detachably mountable to the main body 14 of the electrophotographic image forming apparatus 1 for forming an image on a sheet P which is a recording medium, the main body 14 having

a motor, not shown, provided in the main body 14 of the image forming apparatus,

the apparatus main body gear, not shown, for transmitting the driving force of the motor, the apparatus main body gear being coaxial with and integrally having the driving shaft 100, and

the recess 101 provided in the central portion of the main body gear and which is a non-circular twisted hole rotated with the main body gear and of which the cross-section has a plurality of corners 211c,

wherein the process cartridge 2 comprises

(a) the electrophotographic photosensitive drum 20 comprising

a. the cylinder 200 having a photosensitive layer on the peripheral surface thereof, and

b. the first flange 210 which is a driving-force

transmitting part mounted on one end of the cylinder 200, and having

the second gear portion 221 which is a spur gear for transmitting a driving force received from the main body 14 of the apparatus to the transfer roller 70 provided in the main body 14 of the apparatus when the process cartridge 2 is mounted to the main body 14 of the apparatus,

the first gear portion 213 which is a helical gear provided in juxtaposed relationship with the spur gear 221 for transmitting the drive force received from the main body 14 of the apparatus to the developing roller 41 provided in the process cartridge 2 when the process cartridge 2 is mounted to the main body 14 of the apparatus,

the rotary sliding portion 212 which is a shaft portion provided in juxtaposed relationship with the helical gear 213 and rotatably supported by the drum bearing 302 which is a bearing portion when the photosensitive drum 20 is mounted in the process cartridge 2, and

the protrusion 211 which is a non-circular twisted projection fitted into the recess 101 which is a hole to receive the transmission of the driving force from the main body 14 of the apparatus when the process cartridge 2 is mounted to the main body 14 of the apparatus, and of which the cross-section has a plurality of corners 211c,

and

wherein an area rotatably supported by the bearing portion 302 overlaps an area in which the helical gear 213 is provided when the photosensitive drum 20 is mounted in the process cartridge 2 in the axial direction thereof, and

the driving-force transmitting part transmits the driving force received from the main body 14 of the apparatus through the hole 101 and the projection 211 to the cylinder 200 through the helical gear 213 and the spur gear 221, and

transmits the driving force to the developing roller 41 through the helical gear 213, and

transmits the driving force to the transfer roller 70 through the spur gear 221, and

(b) the developing roller 41 for developing an electrostatic latent image formed on the photosensitive drum 20.

Eighthly, on the end surface of the helical gear 213, a circular recess is provided on a line coaxial with the axis thereof, and the bearing portion 302 slides with the outer peripheral surface of the shaft portion 212 and the inner peripheral surface of the recess which is continuous from the outer peripheral surface, and rotatably supports the shaft portion 212 and the recess.

Ninthly, the photosensitive drum 20 further has the earth pin 215 which is an earth member for grounding the

photosensitive drum 20 to the main body 14 of the apparatus when the process cartridge 2 is mounted to the main body 14 of the apparatus, and which is provided at the center of the driving-force transmitting part 210 through the same in the axial direction thereof.

Tenthly, the driving-force transmitting part 210 is an integrally molded article of resin comprising the fitted portion 214 fitted to one end of the cylinder 200, the spur gear 221, the helical gear 213 and the protrusion 211 molded integrally with one another.

Eleventhly, the tooth width of the spur gear 221 is narrower than the tooth width of the helical gear 213, and the number of teeth of the spur gear 221 is smaller than the number of teeth of the helical gear 213.

Twelfthly, the shape of the protrusion 211 which is a projection is a twisted substantially equilateral triangular prism, and the vertices 211c which are the corners of the substantially equilateral triangular prism are chamfered, and the protrusion is fitted in the recess 101 of which the cross-section is a substantially equilateral triangle.

Thirteenthly, the driving-force transmitting part used in the process cartridge 2 detachably mountable to the main body 14 of the electrophotographic image forming apparatus 1 for forming an image on a sheet P which is a recording medium, the main body 14 having

a motor, not shown, provided in the main body of

the image forming apparatus,

the main body gear, not shown, for transmitting the driving force of the motor, the apparatus main body gear being coaxial with and integrally having the driving shaft 100, and

the recess 101 which is a non-circular twisted hole provided in the central portion of the apparatus main body gear and rotated with the main body gear and of which the cross-section has vertices 211c which are a plurality of corners, and

the driving-force transmitting part having

the fitted portion 214 fitted in the cylinder 200 in order to be mounted on one end of the cylinder 200 of the electrophotographic photosensitive drum 20,

the spur gear 221 for transmitting the driving force received from the main body 14 of the apparatus to the transfer roller 70 provided in the main body 14 of the apparatus when the process cartridge 2 is mounted to the main body 14 of the apparatus,

the helical gear 213 provided in juxtaposed relationship with the spur gear 221 for transmitting the driving force received from the main body 14 of the apparatus to the developing roller 41 provided in the process cartridge 2 when the process cartridge 2 is mounted to the main body 14 of the apparatus,

the rotary sliding portion 212 which is the shaft portion 212 provided in juxtaposed relationship with the

helical gear 213 and rotatably supported by the bearing 302 which is a bearing portion when the photosensitive drum 20 is mounted in the process cartridge 2, and

the protrusion 211 which is a non-circular twisted projection fitted into the recess 101 which is a hole to receive the transmission of the driving force from the main body of the apparatus when the process cartridge 2 is mounted to the main body 14 of the apparatus and of which the cross-section has a plurality of corners 211c, and

wherein when the photosensitive drum 20 is mounted in the process cartridge 2 in the axial direction thereof, an area rotatably supported by the bearing portion 302 overlaps an area in which the helical gear 213 is provided, and the driving-force transmitting part transmits the driving force received from the main body 14 of the apparatus through the hole 101 and the projection 211 to the cylinder 200 through the helical gear 213 and the spur gear 221, and

transmits the driving force to the developing roller 41 through the helical gear 213, and

transmits the driving force to the transfer roller 70 through the spur gear 221.

Fourteenthly, on the end surface of the helical gear 213, a circular recess is provided on a line coaxial with the axis thereof, and the bearing portion 302 slides with the outer peripheral surface of the shaft portion

212 and the inner peripheral surface of the recess which is continuous from the outer peripheral surface, and rotatably supports the shaft portion 212 and the recess.

Fifteenthly, the photosensitive drum 20 further has the earth pin 215 which is an earth member for grounding the photosensitive drum 20 to the main body 14 of the apparatus when the process cartridge 2 is mounted to the main body 14 of the apparatus, and which is provided at the center of the driving-force transmitting part 210 through the same in the axial direction thereof.

Sixteenthly, the driving-force transmitting part 210 is an integrally molded article of resin comprising the fitted portion 214 fitted to one end of the cylinder 200, the spur gear 221, the helical gear 213 and the protrusion 211 molded integrally with one another.

Seventeenthly, the tooth width of the spur gear 221 is narrower than the tooth width of the helical gear 213, and the number of teeth of the spur gear 221 is smaller than the number of teeth of the helical gear 213.

Eighteenthly, the shape of the protrusion 211 is a twisted substantially equilateral triangular prism, and the corners 211c of the substantially equilateral triangular prism are chamfered, and the protrusion is fitted into the hole 101 of which the cross-section is a substantially equilateral triangle.

Nineteenthly, the electrophotographic image forming apparatus 1 for forming an image on a sheet P which is a

recording medium to which the process cartridge 2 is detachably mountable, the electrophotographic image forming apparatus having

(a) a motor,

(b) the main body gear for transmitting the driving force of the motor,

(c) the recess 101 which is a non-circular twisted hole provided in the central portion of the main body gear and rotated with the main body gear and of which the cross-section has vertices 211c which are a plurality of corners,

(d) the transfer roller 70 for transferring a developed image formed on the electrophotographic photosensitive drum 20 to the recording medium P, and

(e) mounting portion for detachably mounting the process cartridge 2, the process cartridge 2 having

(i) the electrophotographic photosensitive drum 2 having

a. the cylinder 200 having a photosensitive layer on the peripheral surface thereof, and

b. the driving-force transmitting part 210 mounted on one end of the cylinder 200, and having

the spur gear 221 for transmitting a driving force received from the main body 14 of the apparatus to the transfer roller 70 when the process cartridge 2 is mounted to the main body 14 of the apparatus,

the helical gear 213 provided in juxtaposed

relationship with the spur gear 221 for transmitting the driving force received from the main body 14 of the apparatus to the developing roller 41 provided in the process cartridge 2 when the process cartridge 2 is mounted to the main body of the apparatus,

the shaft portion 212 provided in juxtaposed relationship with the helical gear 213 and rotatably supported by the bearing portion 302 when the photosensitive drum 20 is mounted in the process cartridge 2, and

the non-circular twisted protrusion 211 fitted into the hole 101 to receive the transmission of the driving force from the main body of the apparatus when the process cartridge 2 is mounted to the main body 14 of the apparatus and of which the cross-section has a plurality of corners 211c, and

wherein an area rotatably supported by the bearing portion 302 overlaps an area in which the helical gear 213 is provided when the photosensitive drum 20 is mounted in the process cartridge 2 in the axial direction thereof, and the driving-force transmitting part transmits the driving force received from the main body of the apparatus through the hole 101 and the projection 211 to the cylinder 200 through the helical gear 213 and the spur gear 221, and transmits the driving force to the developing roller 41 through the helical gear 213, and transmits the driving force to the transfer roller 70

through the spur gear 221, and

(ii) the developing roller 41 for developing an electrostatic latent image formed on the photosensitive drum 2.

According to the aforementioned embodiment, in the first flange as the driving-force transmitting part having the protrusion as the driving-force transmitting means, there is provided a construction in which the first gear portion and the rotary sliding portion overlap each other along the axial direction of the first flange, whereby it is realized to shorten the full length of the first flange without decreasing the gear width of the first gear and the fit length of the rotary sliding portion of the first flange and the bearing member.

Also, by providing a projection shape on the inner side of the rotary sliding portion in addition to the first gear portion and the rotary sliding portion, and making the projection shape (protrusion) overlap the rotary sliding portion along the axial direction of the first flange to thereby realize the further shortening of the full length of the first flange.

Further, in the first flange as the driving-force transmitting part-having the projection shape as the driving-force transmitting means, there is provided a construction in which in addition to the first gear portion as the developing device driving means, the second gear portion as the transfer roller driving means

is made adjacent to the protrusion, whereby the driving shaft and transfer roller gear of the image forming apparatus are made proximate to each other and an improvement in the positional accuracy between the two is facilitated and as the result, the curtailment of the gear width of the second gear portion is realized.

As described above, according to the present invention, the lengthwise sizes of the driving-force transmitting part and the electrophotographic photosensitive drum could be made small and further, the sizes of the process cartridge and the electrophotographic image forming apparatus could be made small.

White the invention has been described with reference to the structure disclosed herein, it is not confirmed to the details set forth and this application is intended to cover such modifications or changes as may come within the purposes of the improvements or the scope of the following claims.